Bay Grasses in Classes
2006

Sago Pondweed Protocol

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Contact Information

If you have any technical questions or equipment problems concerning the Bay Grasses in Classes - Sago Pondweed project, please contact:

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Bay Grass Information on the Internet

Use the Internet to visit bay grass related web sites and find out what is going on with bay grass in your area and elsewhere!

- **www.dnr.state.md.us/bay/sav/ – Maryland DNR bay grass information page. Includes: identification key for Chesapeake Bay species, information on bay grasses, teacher questions, data from previous years of Bay Grasses in Classes, etc.**

- **www.vims.edu/bio/sav - Annual survey of bay grass distribution in the Chesapeake Bay. View maps to see current and historical bay grass distribution.**

- **www.chesapeakebay.net/baybio.htm - Chesapeake Bay Programs Animal and Plant page.**

- **www.npwrc.usgs.gov/resource/literatr/pondweed/pondweed.htm– Detailed information about the biology of sago pondweed.**

- **www.cbf.org - Chesapeake Bay Foundation.**

- **www.gmu.edu/bios/Bay/cbpo/intro.htm - George Mason University's BIOS Project, Introduction to an Ecosystem page**

Reminder for Teachers

IMPORTANT NOTE

At the end of this packet are a Consent and Release and a Volunteer form. Students must have these signed by a parent and returned to teacher before the planting event. Students who do not have a parent's signature WILL NOT BE ALLOWED TO PARTICIPATE

Bay Grasses in Classes Overview

Overview:

Students assemble two bay grass growth chambers and micro-propagate sago pondweed (Stuckenia pectinata) from a parent tray into multiple containers. The only experiment that will be conducted will be temperature. Growth data can be entered on-line at http://mddnr.chesapeakebay.net/bgic/loginindex.cfm. If you do not have web access, fax data sheets to Mark Lewandowski at 410-260-8859. Students investigate the effects of temperature on the health of the plants while learning about the importance of bay grasses to the Chesapeake Bay. In the spring, students will assist scientists in planting their sago pondweed in areas of the Chesapeake Bay designated for bay grass restoration.

Maryland State Assessment Learning Outcomes:

- **Mathematics: Computation; Estimation; Statistics; Number Relationships**
- **Science: Nature of Science; Habits of Mind; Processes of Science; Applications of Science**
- **Reading: To be Informed; To Perform a Task**
- **Social Studies: Geography**
- **Writing: To Inform; To Perform a Task**

Estimated Time:

Total Project Duration: 6 months

- **System set-up: 3 hours (based on 6 students)**
- **System measurements: 5 minutes daily**
- **System maintenance and monitoring: 20 minutes weekly**
- **Planting event: 1 day**

Project Timeline

November:

- $ **Receive sago pondweed parent plants (Note: System set up must be done the day after training)**
- $ **Set up the bay grass growth chamber.**
- $ **Use classroom activities available on the DNR website at http://www.dnr.maryland.gov/bay/sav/bgic/**
- $ **Use Chesapeake Choices and Challenges curriculum (Note: This is copyrighted material, please contact Chesapeake Bay Foundation for more information).**

November- May:

- $ **Grow and micro-propagate sago pondweed**
- $ **Keep track of bay grass growth and water quality data.**
- $ **Use plants in classroom activities and experiments.**

May - June:

- $ **Attend planting event and assist MD-DNR and CBF in planting your sago Pondweed.**

Bay Grass Information

Introduction

How does the Chesapeake Bay keep itself healthy? Just like people rely on their immune systems to fight off germs and viruses, the Bay relies on many factors to fight the effects of sediment and nutrients that wash into it from the land. One of these factors is the bay grass or Submerged Aquatic Vegetation (SAV) that grows in the Bay and in many Bay tributaries.

Bay grass helps to keep the Bay in good shape in a number of ways. By slowing water movement, bay grasses help remove suspended particles from the water. Bay grass beds also stabilize the sediments that are already on the bottom of the Bay, absorb nutrients from the water, produce oxygen, and serve as food and habitat for multitudes of aquatic creatures.

Unfortunately, the bay grasses have been overwhelmed by the same pollutants that they remove from the Bay: sediments and nutrients. When too much suspended sediment from runoff clouds the water, or when excess nutrients cause algae blooms, bay grasses are sometimes not able to get enough sunlight to grow. When beds of bay grass die, the Bay loses important habitats.

This project will allow your class to grow sago pondweed, a type of bay grass, in the

classroom. After your plants are grown, you will work with the Maryland Department of Natural Resources and the Chesapeake Bay Foundation to plant the bay grass in a tributary of the Chesapeake Bay!

Preparation - Educate yourself and your students about bay grass

Before you conduct this project, it is important that you understand the connection between bay grasses and good water quality. Use the activities found in this packet such as "How Scientists Identify a Planting Area", "How Do the Cells of Sago Pondweed Compare With Other Cells?" These activities were designed specifically for the Bay Grasses in Classes project. They are also on the DNR website at http://www.dnr.state.md.us/bay/sav/bgic/. Also, use the activities: "Please Don't Feed the Bay," "When Rain Hits the Land", "A Little Puddle at the Bottom of a Big Hill," What Is Your Watershed Address?," and "Submerged Aquatic Education" from Chesapeake Choices and Challenges (Note: This is copyrighted material. Please contact the Chesapeake Bay Foundation for more information) to determine what sorts of land uses affect bay grass and how the bay grasses have been doing in the river nearest to you.

Materials

Material list for 2 growth chambers (*=not provided)

2 - growth chambers
2 - sponge filters
2 - powerheads
4 - incandescent light bulbs (75 watt)
4 - light shrouds (swing arm desk lamp)
2 - power strips with surge protectors
2 - ground fault interrupters (GFI)
2 - thermometers
2 - submersible aquarium heaters
1 - pH test kit
1 - nitrate test kit
6 - planting trays
1 - foam sheet
1 - bag of topsoil (40 pounds, lower organic content than potting soil)
1 - set sago pondweed plants
1 - *ruler
1 - *bag of sand (50 lbs)
1 - *cup measure
1 - *5 gallon bucket
1 - *about 100 feet of string (depending on the height of your ceilings) - optional

Growth Chamber Assembly

Part 1 – Preparing growth chambers

(Note: Read all instructions for Part 1 before beginning.)

Step 1 – Assembling the growth chambers

It will take one hour to completely set-up one chamber. You can separate the class into two groups and assemble both growth chambers simultaneously.

Materials

2 - growth chambers
4 - desk lamps
4 - incandescent light bulbs
2 - powerheads
2 - sponge filters
2 - power strips
2 - ground fault interrupters (GFCI)
2 - Submersible aquarium heaters

Procedure

1. Once you have all the parts for your bay grass growth chamber, you will need to assemble them in your classroom. If split into two groups, a class of 15 students or more should be able to prepare both growth chambers in one hour. The growth chambers will be very heavy (approximately 100 lbs.) and difficult to move once filled, so choose your location carefully. If possible, do not place by a window.

2. Place growth chambers on table. Make sure the table has strong legs, and is near an empty wall outlet. Label the outside of each tub clearly with an "A" or a "B".

3. Assemble the lights and clamp them to the table so they can sit about 8" above the top of the chamber. Plug the lights into the powerstrip. Install the light bulbs into the lights. Make sure a drip loop@* is set up to prevent water from accidentally dripping into the powerstrip socket
(Fig. 1).

***Teachers Note: It is up to the individual teacher to determine safety precautions to be taken with the lights. If accidentally submerged into the water, the light bulbs will burst and an electric shock of standard household current (120 volts) could result. Anything plugged into an outlet or powerstrip should have a Adrip loop@ to prevent water from accidentally dripping into the socket.**

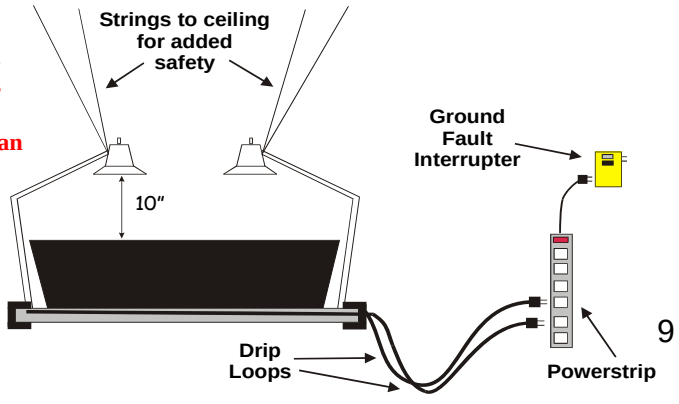


Fig.1 -Tank Setup

4. **Prepare the powerhead by attaching the cylindrical plug of the powerhead to the water intake of the powerhead. Then attach the sponge filter by stretching it over the adapter. The sponge filter will prevent particles from clogging up the powerhead. In addition, it provides a medium for beneficial bacteria to grow. DO NOT plug in the powerhead at this point (Fig. 2).**

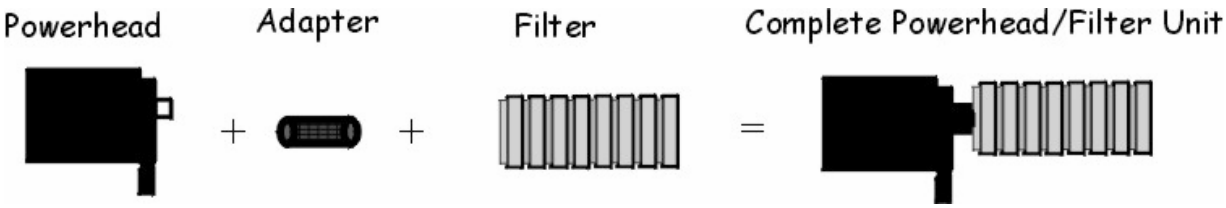


Fig. 2 - Powerhead assembly

(Expect to have many extra parts in the box that will not be needed.)

5. **Using the suction cups, attach the power head along the short side of the growth chamber, causing the flow to be directed down the center of the growth chamber (Fig. 3).**

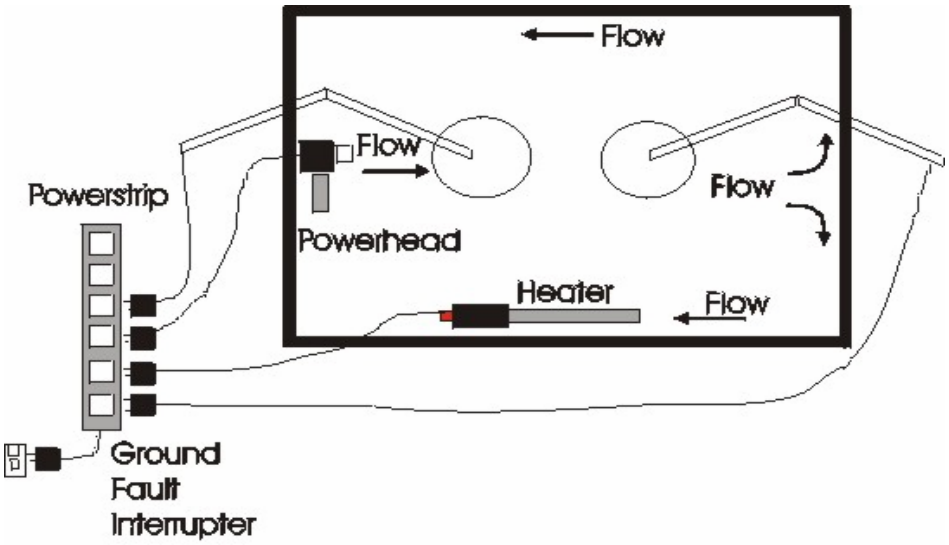


Fig. 3 - Placement of powerhead

Step 2 – Preparing equipment in growth chambers

Materials

2 - bay grass growth chambers (from Step 1)
2 - thermometers
2 - pH test kit
1 - nitrate test kit
2 - submersible aquarium heaters
Initial Water Quality Data Form (page 20)

Procedure

1. **Fill the growth chamber with tap water to 10 cm (4 inches) deep.**

2. **Set the unplugged heater to the assigned temperature. Set Chamber A at 75 degrees Fahrenheit (F^o). Chamber B can be set at either 84 F^o or 92 F^o. Lay the heater in the bottom of the growth chamber. Plug heater into the powerstrip.**

3. **Set up drip loops on all cords so that water cannot run into the outlet. (See Fig. 1)**

4. **Plug the powerstrip into the GFCI and then into the outlet as in the diagram below.**

5. **Plug in the powerhead/filter (and leave it on). It should immediately begin circulating water in your growth chamber. Remember to set-up the drip loops!**

6. **Put the thermometer into the water. It can be attached to the side of the growth chamber with the suction cup, or it can float free.**

7. **Using the instructions in the test kit boxes, test the water quality of your school=s tap water using the nitrate and pH test kits. Record this data on the Initial Water Quality Data form.**

8. **The assembled growth chamber is now complete (Fig. 4).**

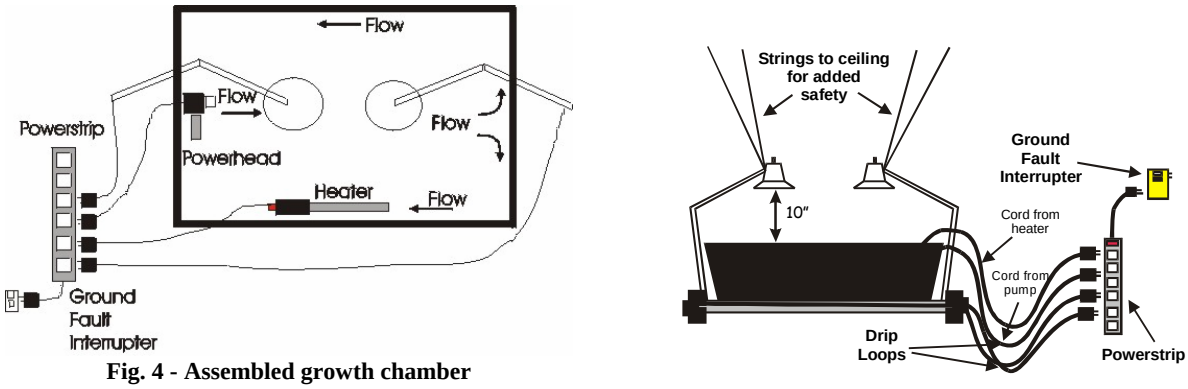


Fig. 4 - Assembled growth chamber

Part 2– Preparing planting trays

(Note: Read all instructions for Part 2 before beginning.)

It will take one hour to prepare all of the planting trays.

Materials

1 - Container of adult sago pondweed
1 - Bag of sand (Not provided)
1 - Bag of topsoil
6 - Planting trays
1 - Foam sheet
1 - 5 gallon bucket (Not provided)
1 - Cup measure (Not provided)

Procedure

1. **Set aside 12 cups of sand that will be used to cover the topsoil/sand mixture.**

2. **Thoroughly mix remaining sand and topsoil in a container (bucket, black tub, etc).**

3. **Use a permanent marker to label the lip of each of the six planting trays or punch holes in the lip with a whole puncher so that you can tell them apart. (Example: A1, A2, A3, B1, B2, B3)**

4. **Fill the 6 planting trays with the topsoil/sand mixture until all 6 are equally full to within about 1/4 inch of the top. Pack the sediment in each tray firmly with your fingertips.**

5. **Sprinkle an additional 2 cups of sand that was set-aside over the topsoil/sand mixture in each tray. This layer should be a very thin. Spread sand evenly so the topsoil/sand mixture is no longer visible.**

6. **Lay the foam sheet on top of the sand topsoil mixture surface. Remember: once the**

foam is in the water, it will float, so hold it in place tightly.

7. **Two people should <u>gently</u> lower the trays into a growth chamber. Tip one end of the tray when lowering, <u>slowly</u>. Hold the foam in place on top of the sediment surface until all bubbling has stopped. This may take quite a while (up to one minute). This will minimize disturbance of the sediment and movement of plants.**

8. **Remove the foam sheet carefully by lifting one end slowly. Repeat procedures 6 through 8 until each growth chamber has 3 trays in it.**

9. **Turn on lights, powerheads and make sure the thermometers are set at the proper temperatures.**

10. **The parent tray will be placed in Chamber B. Fold all sago pondweed plants into the center of the tray, and gently cover them with the foam sheet. Using the directions from step 7, lower the parent tray into the chamber.**

Micro-propagating Sago Pondweed

Part 3 – Micro-propagation

(Read all instructions for Part 3 before beginning. You will need an additional container of water to place the cuttings in during micro-propagation).
It will take one hour to micro-propagate the plants from the parent tray.

1. **When most of the plants in the parent tray have 8 leaves, it will be micro-propagation time. It will take several weeks for the plants to be large enough to micro-propagate. Lift each adult plant from the parent tray one at a time (without pulling the plants out of the sediment), holding them upright from the top of the central stem, and cut into segments of three leaves. Make sure to make the cut from the bottom and just above the leaf (node). Leave two leaves (nodes) on the rooted parent plant (Fig. 5).**

2. **Put all of the cuttings into a container of water. The cuttings must remain wet at all times.**

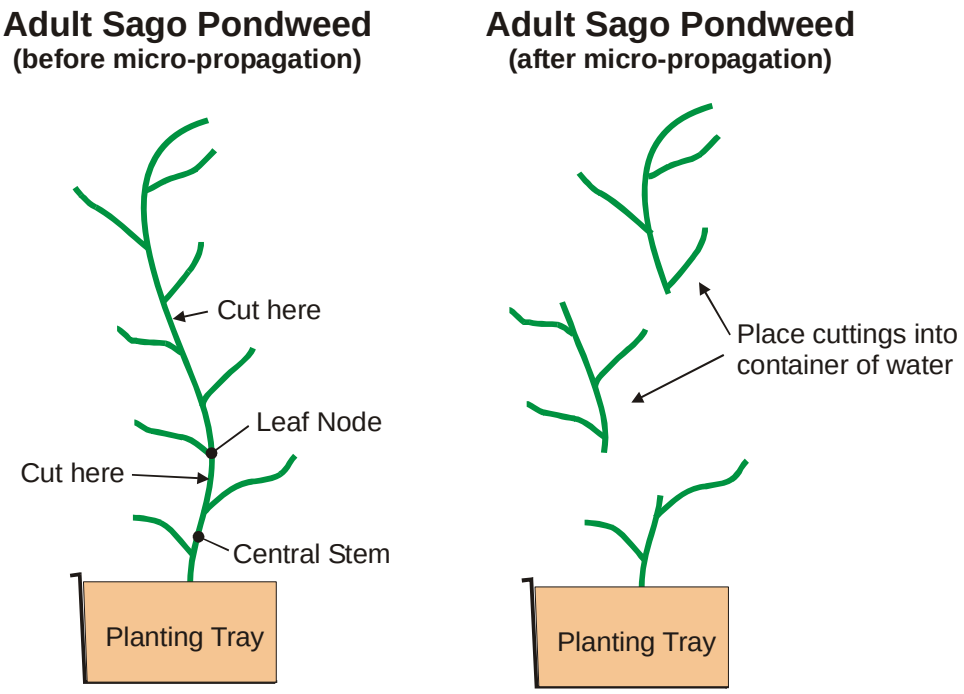


Fig. 5 - Micro-propagating sago pondweed

3. **Divide the cuttings into two groups, one for each growth chamber. The number of cuttings will vary each micro-propagation.**

4. **Plant all of the cuttings for growth chamber A into tray 1. Using the tip of your finger, bury each sago pondweed cuttings so that one leaf is in the sediment and two leaves are above the sediment. Make sure they are evenly spaced from the sides of the tray and the other plants. Smooth the sand flat around the base of the stem (Fig. 6).**

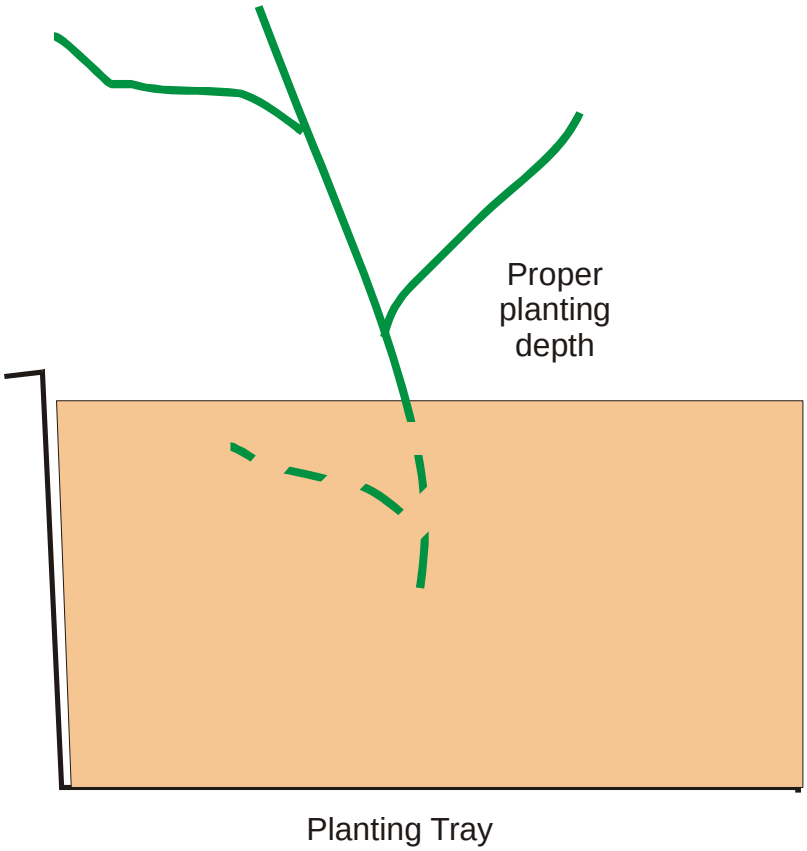


Fig. 6 - Proper planting depth of cuttings.

5. **Repeat until all of the cuttings for chamber A have been planted. Repeat the same procedure for chamber B.**

The tray with the original adult plants will be put into growth chamber B (the elevated temperature growth chamber). There will only be three trays in growth chamber A. Your set up should look like this after the first micro-propagation:

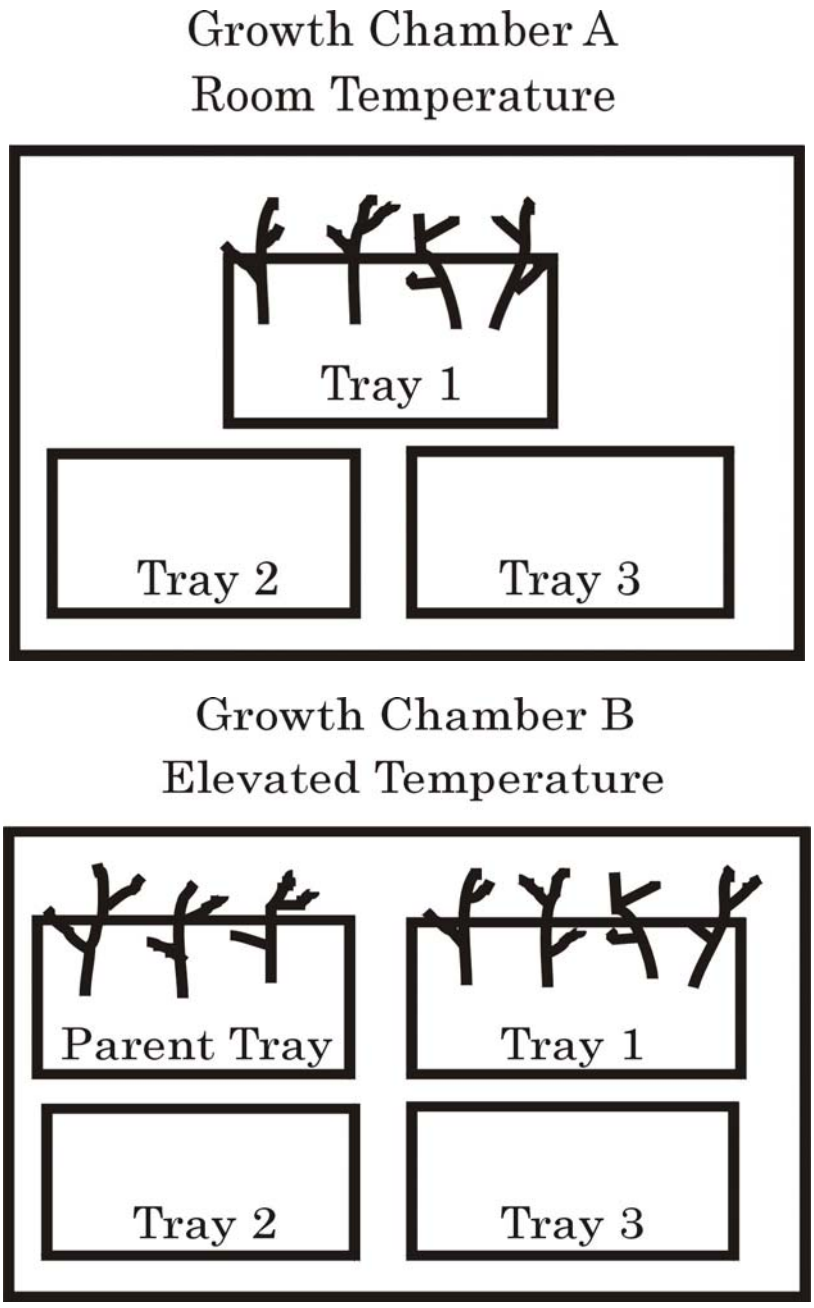


Fig. 7 - Growth chamber setup.

Check the water level weekly and add water when necessary. Be careful not to disturb the sediment. Trays two and three in both growth chambers will remain empty for several weeks. When a majority of the plants in tray one have eight leaves for both growth chambers, it will be time to do your second micro-propagation.

You will cut the plants in tray one of BOTH growth chambers into segments with at least three leaves (as explained on page 14). At the same time, micro-propagate the plants in the parent tray. Put all cuttings from both trays and the parent tray into the same container of water. You will have at least twice the amount of plants after micro-propagation.

Divide those cuttings into two groups, mixing the cuttings from each growth chamber. Using the directions above, plant the cuttings into tray two for each growth chamber. Tray three will remain empty until the 4 tallest plants in tray 2 in each growth chamber have grown eight leaves. When this occurs, the above process will be repeated again. Make sure you micropropagate the parent tray at this time. After tray three has been planted, no more micro-propagation will be done.

Monitoring your Sago Pondweed

Materials

2 - thermometers
1 - ruler
3 - water chemistry test kits (pH, Nitrate, Carbonate Hardness)
1 - Bay Grasses in Classes Data Log

Procedure

You will need to consistently monitor the growth of the bay grasses and the water quality in the growth chamber. A pair of students can easily do the daily monitoring during the first five minutes of each class period, and the weekly monitoring should take no longer than 20 minutes.

1. Daily Monitoring (Record the following information)

- **Water temperature - (F^o)**
- **Water level in the growth chamber - Fill to 16 ½ cm (or 6½ inches) daily**
- **Height of the light above the water surface (Should be 25 ½ cm or 10 inches)**
- **Any additional observations or comments.**

2. Weekly Monitoring

Every week, data must be entered on line at http://mddnr.chesapeakebay.net/bgic/loginindex.cfm. If you do not have access to the Internet, the two data sheets should be faxed to Mark Lewandowski at 410-260-8859. You will measure plant height and observe the number of leaves in tray one of both growth chambers (Fig. 8). You will continue to send data from tray one until a majority of the plants have eights leaves (nodes). At this point, you will be ready to do your second micro-propagation.

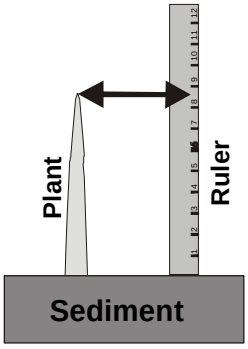


Fig. 8 - Measuring your sago pondweed.

When you have divided your plants for the second time, you will only send data from tray two in each growth chamber. You will continue this until a majority of the plants in the tray have eight leaves, and you will micropropagate for the third time. During each micropropogation, make sure to clip the plants in the parent tray. After the third planting, all data sent will be from tray three.

At this point, all of your trays will have plants in them. They will be roughly the same size. Continue to send data on tray three until planting day or MD-DNR contacts you and instructs you to stop recording.

Preparing for Planting Day

Maryland Department of Natural Resources and the Chesapeake Bay Foundation will identify a nearby site for bay grasses restoration. When your plants reach adult size, you will be able to assist scientists in planting your bay grasses at this restoration location. Your plants, along with those of the other participating schools will increase the size of the new bay grass beds and will increase both its ecological value and its chance of its survival.

1. **Prepare your bay grass for transport the day of or the day before the planting activity. Remove most of water from the bay grass growth chamber by siphoning or dipping, until the water level just barely covers the top of the planting trays. This will reduce the weight, making the growth chambers easier to transport. In order to prevent the plants from drying out during transport, cover the growth chamber with several sheets of wet newspaper. The wet newspaper should be placed directly on the surface of the plants. When you arrive at the planting location, be sure to put your grasses in an area out of direct sunlight and add water to the growth chambers if possible.**

2. **Make sure that you identify your two growth chambers with your school's name and teacher's name.**

Teachers Note: the Chesapeake Bay Trust will provide funding assistance for transportation to Bay Grasses in Classes planting locations. Please complete the attached application form located on (www.chesapeakebaytrust.org/images/word/schoolgrantapplication.doc) and return to the Chesapeake Bay Trust ASAP to provide time for processing. If you do not submit the form before the due date, costs will not be covered.

2006 Bay Grasses in Classes: Initial School Data

(Black ink only please)

School:_____

Teacher:_____

Grade:_____ Class:_____

Phone Number:_____

Email:_____

Address:_____

_____

_____

Initial Water Quality (Tap water):

pH:_____

Nitrate:_____

NOTE: Please fax this page to Maryland DNR c/o Mark Lewandowski at 410-260-8859 after tank set-up.

2006 Sago Pondweed Data Log

School: _____Teacher:_____

Grade/Class: _____ Week # _____
(Week 1 = first micro-propagation)

Chamber Type: (circle one) Chamber A 75˚F/24˚C Chamber B 84˚ F/ 29˚ C Chamber B 92˚F/33˚C

Current week_____ Week of latest Micropropagation _____

Number of Micropropagations _____ When was tank treated with algicide_____
(Black ink only please)

Daily Chamber Monitoring					
Date (month/day)	**Water Temp (°F)**	**(°C)**	**Water Depth (fill to 17 cm or 6 1/2")**	**Light Height (should be 26 cm or 10")**	**Comments (heavy algal growth, cloudy water)**
Monday _____					
Tuesday _____					
Wednesday _____					
Thursday _____					
Friday _____					
Average Temp:					

Weekly Monitoring		
Date	**pH**	**Nitrate**

Tallest plant in tray (cm)	Tallest plant in tray (cm)	Tallest plant in tray (cm)	Tallest plant in tray (cm)	Average Plant Height (cm)
Number of leaves	**Number of leaves**	**Number of leaves**	**Number of leaves**	**Average number of leaves**

NOTE: Please use the on-line data entry system to enter your data. If you can not access the internet, fax this page to Maryland DNR c/o Mark Lewandowski 410-260-8859 at end of each week.

2006 Bay Grasses in Classes

Experiment Diagram and Growth Chamber Set-up

School: _____

Teacher:_____**Email:**_____
(Please use black ink only. Fax to Mark Lewandowski at 410-260-8859. Thanks!)

Between Tank Experiment (Assigned):
(Please circle one.)

flow rate light time sediment type

temperature other

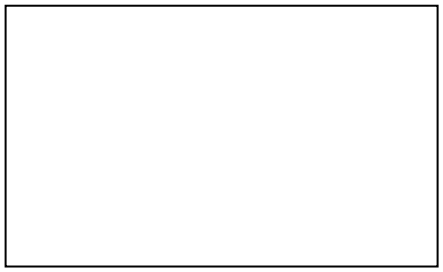
Growth Chamber A:

_____

(Please draw and label.)

(Please circle	One powerhead (flow rate)	no powerhead (flow rate)
all that apply.)	24 hours (light time)	____ hours (light time)
	75 degrees 84 degrees	92 degrees (temperature)
	25%/50%/75% sand	25%/50%/ 75% soil (sediment type)

Growth Chamber B:



_____

(Please draw and label.)

Please circle	One powerhead (flow rate)	no powerhead (flow rate)
all that apply.)	24 hours (light time)	____ hours (light time)
	75 degrees 84 degrees	92 degrees (temperature)
	25%/50%/75% sand	25%/50%/ 75% soil (sediment type)

Consent/ Release Form

As parent or legal guardian of _____, I certify that said child has my permission to attend and participate in the "Bay Grasses in Classes" Program sponsored by the Maryland Department Of Natural Resources. In signing this form, I acknowledge that my child will be participating in the following activities as part of this program: canoeing, seining, nature hikes, and planting grasses in Chesapeake Bay Tributaries. I also hereby grant the Maryland Department of Natural Resources the unconditional right to use the name, voice, and photographic likeness of _____in connection with any of their audio video production, articles, or press releases, but not as an endorsement.
I, _____, hereby give my consent for Emergency Medical Care to be provided for my child, _____, while he/she is participating in the " Bay Grasses in Classes" program.

Physician: _____
Phone Number:(_____)_____
Allergies: _____
In case of such an emergency during program hours, I can be reached at:
_____

_____
Signature of parent or legal guardian Date

RELEASE STATEMENT:
I acknowledge that there are natural hazards with activities in an outdoor setting. I hereby affirm that my child is in good health and physically capable to perform the required activities of the program. In consideration of the Maryland Department of Natural Resources Bay Grasses in Classes Program accepting my child and to the extent permitted and approved by State Law, I hereby release and forever discharge the State of Maryland, its units, agents, and employees from all claims of liability for any damages or injuries which may be sustained while my child is at camp to the extent permitted by state law.

_____ _____
Parent/Guardian Signature Date

Maryland Department of Natural Resources
Tidewater Ecosystem Assessment
Tawes State Office Building
580 Taylor Avenue D-2
Annapolis, MD 21401

Maryland Department of Natural Resources
Resource Assessment Service
Volunteer Information & Registration

This registration form between the MD Department of Natural Resources and each volunteer is subject to the following terms and conditions:

1. Registration. ALL volunteers must register on forms provided prior to doing any work. Registration qualifies the volunteers for State liability and medical protection.

2. Duties. No volunteer should undertake any work or use any equipment for which he/she is not trained and qualified. Volunteers are not permitted to drive a State Vehicle. Volunteers must use the same safety equipment required of the Department of Natural Resources personnel conducting similar activities. Volunteers who operate their own power equipment do so at their own risk.

3. Liability. Volunteers, like other State employees, are immune from tort liability if they are acting within the scope of their assigned public duties and without malice or gross negligence even if the damages exceed the limits of the State=s waiver of immunity. Volunteers sued for alleged negligence are eligible for State legal assistance provided the limitations are not violated. The Department of Natural Resources relinquishes any claim for loss or damage to State property which results from supervised activities in State facilities, provided those activities are conducted without malice or gross negligence.

4. Medical Coverage. The State Treasurers Office provides volunteers with accident/medical insurance in the amount of $2,500 for personal injuries and accidental death/dismemberment insurance in the amount of $10,000. Proof of claim forms must be submitted to the Department of Natural Resources within thirty (30) days of the date of the accident.

5. Coordination. The volunteer program will be coordinated by Mark Lewandowski. Specific questions or concerns should be address to her/him at 410-260-8634. This form covers the period of ____4/29/06_____ to _____6/20/06_____.
Volunteer Name:_____
Address:_____
_____
Telephone:_____

I acknowledge that I have read and understood the above information and understand that by signing this statement I am considered a DNR volunteer.

Signature_____ Date: _____